U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Metabetaeus lohena

Common Name:

Anchialine Pool shrimp

Lead region:

Region 1 (Pacific Region)

Information current as of:

06/19/2014

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

___ Range is no longer a U.S. territory

___ Insufficient information exists on biological vulnerability and threats to support listing

___ Taxon mistakenly included in past notice of review

___ Taxon does not meet the definition of "species"

___ Taxon believed to be extinct

___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Hawaii, HI, Honolulu, HI, Maui, HI
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Hawaii, HI, Honolulu, HI, Maui, HI
- **Countries**: Chile, United States

Land Ownership:

On Maui and Hawaii, the pools are located on State-owned lands in the State Natural Area Reserve (NAR) System and on Federal lands managed by the National Park Service (NPS). On Oahu, pools are located on State lands owned by the States Division of Aquatic Resources (DAR) and Parks and Recreation Department and on Federal lands managed by the U.S. Fish and Wildlife Service (FWS).

Lead Region Contact:

ARD-ECOL SVCS, Jesse D'Elia, 5032312349, jesse_delia@fws.gov

Lead Field Office Contact:

PACIFIC ISLANDS FISH AND WILDL OFC, Kristi Young, 808-792-9419, kristi_young@fws.gov

Biological Information

Species Description:

Metabetaeus lohena grows up to 18 millimeters (mm) (0.7 inches (in)) in length, and body coloration ranges from pale-pink to brilliant red. There is a conspicuous mandibular (mouthpart) spot (Banner and Banner 1960, p. 301). Its chelae (claws) are relatively large and conspicuous.

Taxonomy:

Metabetaeus lohena was described by Banner and Banner (1960, pp. 299-303). This species is recognized as a valid taxon in Holthuis (1973).

Habitat/Life History:

Metabetaeus lohena is known to occur in both low and high salinity anchialine pools on the Hawaiian islands of Maui and Hawaii, and possibly on Oahu. Anchialine pools are land-locked bodies of water that occur coastally but are not openly connected to the ocean. They are mixohaline (or brackish), with salinities ranging from 2 parts per thousandth (ppt) to concentrations just below that of sea water (32 ppt) (Maciolek 1983, pp. 607-612; Brock et al. 1987, p. 200). Anchialine pools are subject to tidal fluctuations. Except for some records of endemic eels, anchialine pools do not support native species of fish although some species of nonnative fish have been introduced and are currently recognized as problems (see Disease or Predation section below) (Bailey-Brock and Brock 1993, p. 354; Brock 2004, p. i). Locomotion by this species is accomplished by crawling along the substrate. Although it has been thought to feed on another anchialine pool shrimp, *Halocaridina rubra* (Holthuis 1973, p. 36), close observation in captivity and in the field indicate that they are likely not primarily predators (Iwai 2010, pers.comm.).

Historical Range/Distribution:

Although anchialine pools are widespread, being found in areas such as Saudi Arabia, Madagascar, Fiji, and other Indo-Pacific islands, the total area occupied by them globally is extremely small (Maciolek 1983, p. 607). While a number of species of anchialine pool shrimp have disjunct, global distributions within these habitats, most geographic locations contain some endemic taxa (Maciolek 1983, p. 607). *Metabetaeus lohena* is one of these endemic taxa known only from the islands of Maui, Hawaii, and Oahu in the state of Hawaii. Historically, *M. lohena* has been reported from at least 61 anchialine pools on the islands of Maui, Hawaii, and Oahu (HBMP 2006).

Current Range Distribution:

During Brocks (2004, pp. 30-57) most recent survey of Ahihi-Kinau Natural Area Reserve (NAR), located on the island of Maui, *Metabetaeus lohena* was observed in nine pool groups. On the island of Hawaii, the State has been conducting surveys of Manuka NAR since 2008 and found *M. lohena* in 13 pools (Sakihara, in litt. 2010). Additionally, on the island of Hawaii, sites including Manuka, Honaunau, Papawai, Kaloko, Honokohau, Kiholo, Weliweli, Kapalaoa, Aiopio, and Apua Point also support *M. lohena* populations (Conry, in litt. 2012). *M. lohena* was found in one pool at Halape in Hawaii Volcanoes National Park (Jones, in litt. 2010). On the island of Oahu, *M. lohena* has been found in one pool in the Waianae region on

State-owned property, one pool at Malaekahana State Park, and, due to recent restoration efforts, this species now occurs in four pools at the Kalaeloa Unit of the Pearl Harbor National Wildlife Refuge.

Population Estimates/Status:

Like other anchialine pool shrimp species, this species inhabits an extensive network of water-filled interstitial spaces (cracks and crevices) leading to and from the actual pool, a trait which has precluded researchers from ascertaining accurate population size estimates (Holthuis 1973, p. 36; Maciolek 1983, pp. 613-616). Often, surveys for many rare species of anchialine pool shrimp, including *Metabetaeus lohena*, involve a present or absent survey approach in their respective habitat (often with the aid of baiting). Absence, and presumably extirpation of shrimp species from suitable habitat is likely the best or only measure of species decline as population sizes are not easily determined (Holthuis 1973, pp. 7-12; Maciolek 1983, pp. 613-616).

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

On the island of Hawaii, it is estimated that up to 90 percent of the anchialine pools have been destroyed or altered by human activities (Brock 2004, p .i). The more recent human modifications of anchialine pools include the bulldozing and filling of pools (Bailey-Brock and Brock 1993, p. 354). Dumping of refuse and the introduction of nonnative fish (see Disease or Predation section below) have impacted other anchialine pools on this island (Brock 2004, pp. 13-17).

Brock (2004, pp. 13-17) identified the use of anchialine pools as dumping pits as an example of habitat degradation. Brock also noted that garbage-like bottles and cans appear to have no negative impact, while the dumping of used oil, grease and oil filters has resulted in the disappearance of another species of anchialine pool shrimp, *Halaocaridina rubra*, from a pool adjacent to Honokohau Harbor on the island of Hawaii.

The pools on Maui and Hawaii Island where *Metabetaeus lohena* occurs are within state NARs and a National Park. Dumping is known to occur in both NARs and while none has yet occurred within the pools, this threat remains a possibility (Brock 2004, pp. 13-17). In 2006, on the island of Oahu, FWS employees documented dumping of trash and animal remains in one of the pools occupied by this species. Clean up immediately followed and *M. lohena* was subsequently seen in the pool (Wada 2006, pers. comm.).

Trampling damage from use of anchialine pools for swimming and bathing has been documented in the Hawaiian Islands (Brock 2004, pp. 13-17). Similar impacts to the anchialine pools occupied by this species on the island of Hawaii and Maui are possible but have not, at present, been documented. The pools on Oahu are too small to be used for swimming or bathing.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

The FWS has become aware of companies and private collectors using anchialine pool shrimp and related shrimp species for commercial sales of self-contained aquariums similar to those marketed by Ecosphere Associates, Inc. (Ecosphere Associates 2006, p. 1). One company located in Hawaii, Fuku Bonsai, has been using Hawaiian anchialine pool species for the aquarium hobby market for several years (Fuku-Bonsai 2007, p. 1). For commercial purposes, a Hawaii Department of Land and Natural Resources-Division of Fish and Wildlife issued Native Invertebrate Research and Collecting permit is required to collect anchialine pool shrimp. All terrestrial and aquatic invertebrates (including anchialine pool shrimp) are protected under (1) the State of Hawaii Revised Statutes (1993) Chapter 195D-4-f License; and (2) Department of Land and Natural Resources (DLNR) Chapter 124 Indigenous Wildlife, Endangered and Threatened Wildlife, and Introduced

Wild Birds (Conry, in litt. 2012). Collection is prohibited in State NARs but not in the State Parks or City and County property where some anchialine pools occur.

C. Disease or predation:

In Hawaii, predation by introduced nonnative fish is considered to be the greatest threat to native shrimp within anchialine pool ecosystems (Bailey-Brock and Brock 1993, p. 354; Brock 2004, pp.13-17). Anchialine pools have been used to both discard and hold bait-fish and/or aquarium fish (Bailey-Brock and Brock 1993, p. 354). These fish either directly consume the native shrimp or, as with introduced tilapia fish (*Oreochromis mossambica*), outcompete the native herbivorous species of shrimp that typically serve as the prey-base for the rarer, predatory species of shrimp, thereby disrupting the natural and delicate ecological balance in these systems (Bailey-Brock and Brock 1993, p. 354). Introduction of nonnative fish including bait-fish into many of Hawaiis anchialine pool systems may have been a major contributor to the decline of the pools and the shrimp inhabiting them (Brock 2004, pp.13-17).

Invasion, with human assistance, of anchialine pools by nonnative fish is a potential threat and is the most significant threat to anchialine pool shrimp and their habitat since all the pools are easily accessible to the public. Within the State NARs, disturbance of the pools is prohibited and informative signs have been placed at the sites. However, signs may not be an adequate deterrent. For example, since 1985 signage was posted to warn people from entering the Waikoloa Achialine Pond Preserve at Waikoloa, North Kona, Hawaii. Visitors were not allowed into the pool preserve but could walk around the perimeter. In December 2003, it was discovered that someone had released tilapia and mosquito fish into the system. Within six months following the introduction, nonnative fish had invaded two-thirds of the system and all the anchialine pool shrimp disappeared (Brock 2004, pp. 13-17).

Nonnative fish species were not seen during the most recent survey of the Maui and Hawaii Island pools where *Metabetaeus lohena* occur (Brock 2004, p. i). In 2006 there was no evidence of nonnative fish in either of the pools on the island of Oahu during site visits by FWS employees (Wada 2006, pers. comm.).

D. The inadequacy of existing regulatory mechanisms:

Metabetaeus lohena currently receives no protection under Hawaii's endangered species law (HRS, Sect. 195-D) or the Federal Endangered Species Act (16 U.S.C. §1531-1544). Although there are no existing regulatory mechanisms that specifically protect this species, the pools located within the State NARs are protected by state statutes that prohibit the removal of any native organism and the disturbance of pools (Administrative Rules, Sect. 13-209-4). The State NARs were created to preserve and protect samples of Hawaiian biological ecosystems and geological formations; and are actively managed and monitored for their unique ecosystems. However, while signs are posted that provide notice to the public that the pools are off-limits to bathers and other activities that could damage the pools, the States NARs have no funding for proper enforcement to stop such activity.

E. Other natural or manmade factors affecting its continued existence:

Even if the threats responsible for the decline of this species were controlled, the persistence of existing populations is hampered by the small number of extant populations and the small geographic range of the known populations. This circumstance makes the species more vulnerable to extinction due to a variety of natural processes. Small populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988; Center for Conservation Biology 1994). Small populations are also demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio (Lande 1988). In addition, large-scale water

withdrawal from underground water sources may impact anchialine pools. This underground water withdrawal may increase salinity levels and negatively impact species that rely on the delicate balance of the mixohaline habitats (Conry, in litt. 2012).

Conservation Measures Planned or Implemented :

The pool groups containing *Metabetaeus lohena* lie within the Ahihi-Kinau and the Manuka State NARs on Maui and Hawaii Volcanoes National Park on Hawaii. Ahihi-Kinau was the first NAR to be established by the State of Hawaii, and in fact, the presence of the anchialine pools and their rare resident shrimp species was a key reason this area received this designation (Holthuis 1973, pp. 4-5). This species receives some protection under the State statutes that specifically prohibit the disturbance or removal of any plant or wildlife and the disturbance of any pond or lake. In addition, signs have been placed at the pool locations at both NARs prohibiting entry into and disturbance of the pools.

In August 2007, the FWS jointly resurveyed Ahihi-Kinau State NAR with personnel from both the State NAR and DAR. We found no evidence of any non-native fish in the pools we surveyed and we found *M. lohena* in all of the known population sites.

On the island of Oahu, at the Pearl Harbor National Wildlife Refuge, Kalaeloa Unit, anchialine pool restoration efforts have been completed. Thirteen out of fourteen pools in this locality have been completely restored and another anchialine pool shrimp, *Halocaridina rubra*, has recolonized all of the pools to date. In addition, *M. lohena* has naturally recruited into four of the pools.

On June 16, 2008, a symposium on anchialine pool conservation and management was held at the 89th annual meeting of the American Association for the Advancement of Science, Pacific Division. In addition, a statewide meeting concerning the monitoring of anchialine pools was hosted by the FWS on January 15, 2009. Results of that meeting include an update on the status of monitoring efforts across the State, initiated development of a common monitoring protocol, and the establishment of an anchialine pool shrimp listserv. In May 2010, the FWS again jointly surveyed Ahihi-Kinau State NAR with personnel from both the State NAR and DAR. We found no evidence of nonnative fish in the pools surveyed and *M. lohena* was found present in all known population sites.

In July 2010, FWS jointly surveyed Pohiki with State NAR and DAR personnel. The pool is a hot spring with much warmer water than the nearby ocean and many people were swimming and soaking in it. However, *M. lohena* were present along the sides of the pool and on portions of the bottom of the pool.

In February 2011, FWS reviewed and commented on the National Park Services draft long term monitoring plan for anchialine pools within their boundaries on the island of Hawaii.

Summary of Threats :

Based on our evaluation of habitat degradation and loss due to bulldozing and illegally dumping trash or fill in anchialine pools and the effects of predation by nonnative fish, we conclude there is sufficient information to develop a proposed listing rule for this species due to the threat of habitat destruction or contamination by dumping of trash or fill, bulldozing, and the release of nonnative fish into any one of the known pools where *Metabetaeus lohena* occurs. In addition, overcollection by the aquarium hobby market is a potential threat to the species. Collection of *M. lohena* is prohibited in both NARs, as is disturbance of the pools. Enforcement of these prohibitions is difficult and the negative effects from the introduction of nonnative fish could still occur quickly and suddenly. Collection and disturbance are not prohibited at either site on Oahu. We find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

- Monitor known pool habitats for evidence of trash dumping, presence of nonnative fish and other habitat changes, and take appropriate action if evidence indicates impacts to the pools
- Conduct ecological research on habitat requirements and basic life history of M*etabetaeus lohena*
- Conduct research on the captive propagation of *M. lohena*

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	**5**
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

The threats to *Metabetaeus lohena* from habitat degradation and destruction and predation by nonnative fish are of high magnitude because this species occurs in only 26 pools in three localities across three islands. All individuals of this species within a pool may be adversely impacted by a single dumping of trash or release of nonnative fish into any of its remaining population sites.

Imminence :

Threats to *Metabetaeus lohena* from nonnative fish, dumping of trash or fill, recreational activities, development and overcollection are non-imminent because they are not on-going. Nonnative fish are not currently present in the pools in which *M. lohena* currently occurs.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the species' total populations within the time frame of the routine listing process. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *Metabetaeus lohena* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

Description of Monitoring:

We conducted literature searches for recent articles on this species and contacted relevant species experts. The U.S. Geological Survey-Biological Resource Discipline, State officials with the DLNR, and Bishop Museum, University of Hawaii, and Auburn University researchers were contacted regarding the current status of this species. No additional information on the species status was found over the past year.

This level of monitoring is appropriate to update the status of the species because a thorough literature search was conducted and relevant species experts were contacted. Information contained in this assessment form was verified by species experts.

List of Experts Contacted:

Thomas Iwai March 1, 2012 DAR (Retired)
Annette Tagawa March 1, 2012 DAR
Troy Sakihara March 1, 2012 DAR
Scott Santos March 1, 2012 Auburn University
Matt Ramsey March 1, 2012 NOAA
Hawaii Anchialine-Pool Listserv March 1, 2012

The Hawaii Biodiversity and Mapping Program (HBMP) lists this species as imperiled (HBMP 2006). *Metabetaeus lohena* is included in the list of species in Hawaiis 2005 Comprehensive Wildlife Conservation Strategy (Mitchell et al. 2005). In addition, in March 2007, the State of Hawaii initiated a separate strategic plan focusing exclusively on invertebrates. It is expected that *M. lohena* will be one of the species covered by the new plan (Mitchell et al. 2005).

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

none

Indicate which State(s) did not provide any information or comment:

Hawaii

State Coordination:

On February 20, 2013, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. No additional information or comments on this species were received from the State. We are in frequent contact with State biologists and believe this assessment contains the most recent available information on the species.

Literature Cited:

Anker, A. 2010. *Metabetaeus* Borradaile, 1899 revisited, with description of a new marine species from French Polynesia (Crustacea: Decapoda: Alpheidae). Zootaxa 2552: 37-54.

Bailey-Brock, J.H., and R.E. Brock. 1993. Feeding, reproduction, and sense organs of the Hawaiian anchialine shrimp *Halocaridina rubra* (Atyidae). Pacific Science 47:338-355.

Banner, A.H., and D.M. Banner. 1960. Contributions to the knowledge of the Alpheid shrimp of the Pacific Ocean; Part VII. On *Metabetaeus* Borradaile, with a new species from Hawaii. Pacific Science 14:299-303.

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Ecosphere Associates. 2006. Ecosphere Associates Inc. The perfect balance of science and art. http://eco-sphere.com, accessed on April 6, 2007.

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Lande, R. 1988. Demographic models of the northern spotted owl (*Strix occidentalis caurina*). Oecologia 75:601-607.

Maciolek, J.A. 1983. Distribution and biology of Indo-pacific insular hypogeal shrimps. Bulletin of Marine Science 33:606-618.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. Hawaiis Comprehensive Wildlife Conservation Strategy. Department of Land and Natural Resources. Honolulu, Hawaii. 722 pp.

Personal Communications and In Litteris

Conry, P.J. CNOR 2012, Response to request for comments on FWS species assessment and listing priority assignment forms, April 9, 2012.

De Grave, S. Oxford University Museum of Natural History, Oxford, UK. Email in response to request for information, dated March 2, 2012.

Iwai, T. Owner, Island Aquaculture & Aquaponics. (Retired DAR) Phone conversation. January 11, 2010.

Jones, T. Data Analyst, NPS. Email in response to request for information, dated March 26, 2010.

Sakihara T. Biologist, DAR. Email in response to request for information, dated March 29, 2010.

Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  06/18/2014
Date

Concur:  11/18/2014
Date

Did not concur: _____ _____
Date

Director's Remarks: